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WATER QUALITY OF THE LABRADOR-QUEBEC WATERSHEDS LITTLE MECATINA AND NATASHQUAN RIVERS

IWD-AR-WQB-83-51

INLAND WATERS DIRECTORATE
ATLANTIC REGION
WATER QUALITY BRANCH
MONCTON, NEW BRUNSWICK

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LABRADOR-QUEBEC WATERSHEDS

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ENVIRONMENT CANADA

D.M. Lockerbie

T.A. Clair

Water Quality Branch

Atlantic Region

Moncton, N. B.

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FOREWORD

The border between Labrador and Quebec follows the 52° latitude line from near the Strait of Belle Isle to approximately 65°50' longitude, from where it follows the Romaine River to its source and then the height of land up to the Ungava Peninsula. The lakes and rivers which straddle the southern border are all located in isolated areas, with no easy access. Thus, they have not been developed, although the potential does exist for hydro-electric dam construction and the exploitation of forest resources in some of the transboundary basins. If harvesting of these forest resources were to occur, water quality in these transboundary basins could be adversely affected.

Due to their inaccessibility and lack of human activity, the basins in this area have not been well surveyed in terms of water, sediment, and biota quality. As part of its mandate to monitor quality of interprovincial waters for baseline evaluation and for setting quality objectives, the Water Quality Branch, Inland Waters Directorate of Environment Canada (Atlantic Region) has initiated a comprehensive survey of the major transboundary watersheds of Labrador and Quebec. This report describes the results from the surveys of the Little Mecatina-Joir Rivers and the East Natashquan at the interprovincial boundaries.

Avant-Propos

Le Labrador est limite au sud par le 52° de latitude, du detroit de Belle Isle jusqu'a environ 63°50' de longitude, ou la ligne frontaliere longe la riviere Romaine vers le nord jusqu'a sa source. La frontiere s'etend alors vers le nord jusqu'a la Baie d'Ungava, en suivant les sommets les plus hauts.

Les lacs et les rivieres coupes transversalement par la frontiere sud font partie d'une region isolee, difficile d'acces, ou le potentiel de developpement hydro-electrique et d'exploitation forestieres ne fait aucun doute. Si l'exploitation de cette ressource devait avoir lieu, la qualite de l'eau de ces bassins limitrophes serait grandement affectee.

Due a leur inaccessibilite et a l'absence d'activite humaine, les ressources aquatiques de cette region n'ont pas ete etudiees du point de vue qualite d'eau, de sediments ou de qualite chimique de poissons. Etant donne sa responsabilite de surveillance de la qualite des eaux dans les bassins interprovinciaux, d'evaluation de base ainsi que de l'etablissement d'objectifs de qualite d'eau, la Direction generale des Eaux interieures, Direction de la Qualite des Eaux, d'Environnement Canada (Region de l'Atlantique) a inaugure une serie d'etudes dans les bassins transfrontalieres du Labrador et Quebec. Ce rapport presente les resultats des investigations concernant le bassin de la riviere Petite Mecatina-Joir et celui de la riviere Natashquan-Est.

INTRODUCTION

The two river basins are adjacent to each other. The Little Mecatina River originates in southern Labrador in the Dominion Lake region and discharges into the Gulf of St. Lawrence near Tete a la Baleine on Quebec's North Shore (Fig. 1). The Riviere Joir, a major tributary of the Little Mecatina River originates near the height of land forming the divide between the Little Mecatina River Basin and the St. Augustin River Basin, and flows in a general S.S.W. direction to its confluence with the Little Mecatina River at a point approximately 10 river km downstream of the Labrador-Quebec boundary. At the Labrador-Quebec border, the Little Mecatina-Joir System drains an area of 8210 km^2 or 44% of the total basin area of 18,454 km^2.

The basin above 52° latitude lies near the boundary between the Newfoundland-Labrador Barrens Section and the Northeastern Transition Section of the Boreal Forest Region. The vegetation is stunted and open with a patchy cover of black spruce (Picea mariana), balsam fir (Abies balsamea) and white birch (Betula papyrifera), alternating with moss-and-heath barrens covered with reindeer lichen (Cladonia rangiferina), rock outcrops and numerous small lakes.

At the interprovincial border, the Little Mecatina forms Donquan Lake, with Fourmont Lake upstream of it and Lac LeBreton below. These lakes are actually river expensions, but when summer and fall stream flows are low, the water bodies behave as lakes.

The Water Resources Branch (W.R.B.) operates a stream gauge on the Little Mecatina River approximately 80 river km from the upstream inlet to Lac Donquan. This gauge measures the discharge from a drainage area of 4,545 km^2. The daily mean discharge for the period when the survey was conducted ranged from 98-115 m^3/s with an average for the period of 107 m^3/s. The daily mean discharge average for the year 1980 at this point on the river was 133 m^3/s with the yearly maximum being 793 m^3/s on May 22 and the yearly minimum daily mean discharge being 13.1 m^3/s on March 16.

The Water Resources Branch (W.R.B.) also operate a stream gauge on the Riviere Joir approximately 37 river km upstream from its confluence with the Little Mecatina River. The gauge measures the discharge from a drainage area of 2060 km^2. The daily mean discharge for the period when the survey was conducted in 1980 ranged from 37.2-41.1 m^3/s with an average for the period of 39.3 m^3/s. The daily mean discharge average for the year 1980 at this point on the river was 62.5 m^3/s with the yearly maximum being 364 m^3/s on May 22 and the yearly minimum daily mean discharge being 4.13 m^3/s on March 16.

The surface area of Lac Donquan itself is approximately 14.5 km^2. The surficial geology of the upper watershed is composed in roughly equal parts of precambrian basic gneisses and gabbros and granitic gneisses, overlain by thin podzols. Most of the watershed exhibits little relief, with elevations ranging from 280 - 500 m.,

although much of the extreme northwestern part of the watershed is at an elevation of from 500 to 1000 m. The surface elevation of Lac Donquan is 280 m.

The Upper Natashquan River watershed begins approximately 60 km south of Winokapau Lake in southwestern Labrador and discharges into the Gulf of St. Lawrence at Natashquan, Que. The total watershed area is 15,348 km^2 with approximately 37% of this area being in Labrador. (Fig. 2).

The Natashquan Basin in Labrador lies within the Northeastern Transition section of Boreal Forest Region. Here the land is a patchwork of lakes, rivers and string bogs (Sphagnum ssp) with areas of upland barrens and of open woodland of predominantly black spruce (Picea mariana) and a ground cover of reindeer lichen (Cladonia rangiferina). On the hillsides, associated with the black spruce, some white spruce (Picea glauca) tower conspicuously above the lower black spruce canopy. Also found on the hillsides are clumps of white birch (Betula papyrifera) with narrow strips of tamarack (Larix laricina) lining the shores of Lac Fonteneau. The study of water, sediment and fish quality was concentrated on the lake as it crossed the interprovincial boundary and emptied into the East Natashquan.

Lac Fonteneau has a maximum length of 43.3 km, a maximum width of 1.9 km and a total lake surface area of 51 km^2. With its major axis aligned in a SE-NW direction, the lake straddles the Labrador-Quebec

boundary and drains an area of approximately 635 km^2 westward into the East Natashquan River which flows into the Natashquan River at a point 90 km south of the Labrador-Quebec boundary. Most of the lake basin is located on granite thinly covered by a podzol soil. The lake elevation itself is approximately 399 m. above sea level with surrounding hills rising to 550 m.

METHODS

In September 1980, a week-long sampling of Lac Donquan - Riviere Joir was conducted. All field sampling equipment, including a motor and a inflatable boat were flown to the lake, and a camp was set up. The field work in the Natashquan basin was done in September 1981, using similar methods and equipment.

Limited hydrographic surveys of both lakes were conducted using a recording echo-sounder equipped with a 208 KHz frequency transducer mounted over the side of a small boat. The water and bottom sediment sampling sites were located at points in the lake where echograms indicated a soft bottom type. A 92 m long gill net with 46 m of 7.6 cm mesh and 46 m of 9 cm mesh was set at locations chosen on the basis of lake characteristics. The sites sampled are shown in Figures 2 and 3 and are listed in Tables 1 and 1a.

Sampling of water and sediment was done using Standard Water Quality Branch field methods (1982). Sediment samples were taken using an Ekman grab sampler. Fish and sediment samples were wrapped in aluminum foil for organic contaminant analyses or plastic bags for metal analyses and kept cool until they were frozen after returning to Goose Bay.

All parameters for water and sediment were analyzed using standard Water Quality Branch methods (1979). The fish tissue analyses for all

parameters were done using the methods for sediments, with the same extraction procedures.

RESULTS

Water and Sediment

The results of major ion analyses for the water samples are shown in Tables 2 and 2a, with Table 3 showing the parameters which were not detectable in either basin using current WQB techniques. The parameter values indicate very soft oligotrophic waters which contain no detectable levels of inorganic contamination.

Table 4 lists the trace organics for which water and sediment samples were analyzed. In all but one case, water and sediments showed no detectable levels. The exception was for the sediments of Lac Fonteneau, where triplicates from all the four sites showed PCB values ranging from trace level to 0.015 mg/kg. The highest concentration (0.014±.001) being at the head of the lake, and the lowest at station 51QU02WB0003 (Trace) near the lake outflow. Another site, closer again to the lake outflow, contained measurable levels (0.008±.001).

Fish

Few fish were caught in Lac Donquan, while a greater number were caught in Lac Fonteneau. Appendices I and II show the species and meristic characteristics of the individuals caught. The metals and organic contaminants analyzed for are shown in Tables 5 and 6. Not all

analyses were done on all fish, due to the sample sizes required for analysis. Results of the metal analyses are shown in Table 7 and 7a and show detectable levels of mercury in all tissue samples. In some samples, cadmium was also found in livers and gonads. Three samples of Natashquan fish also contained measurable amounts of lead.

Of all the organic contaminants analyzed for, only p,p-DDE and arochlors (PCB) were found at detectable levels in fish from both lakes. Alpha-BHC, an organochlorine was also found at low levels in fish from Lac Fonteneau (Tables 8 and 8a). p,p-DDE, a degradation by-product of DDT was found mostly in liver tissues, as were arochlors. Muscle tissues did not consistently show detectable levels of contaminants, but nevertheless, positive values were observed. Though few samples were analyzed, gonadal tissues also showed detectable levels.

DISCUSSION

Water quality of the two basins studied has been shown to be pristine. Waters in both were soft, slightly coloured and poorly buffered, with generally low alkalinity levels. Of all the parameters analyzed, both inorganic and organic, none showed any levels that would be a cause for further study. The major ion concentrations of both lakes showed very dilute waters typical of Canadian Shield lakes. Little weathering of granitic bedrock occurs, and this is shown by the low concentrations of both cations and anions. The waters had high dissolved oxygen levels. The colour levels can be interpreted to show that there is some organic acidity in the water, originating in the podzolic soils.

Sediment parameter values also were of little importance except for measurable amounts of arochlors (PCB's) in all the Lac Fonteneau samples. A trend of decreasing levels from up-lake to the lake's mouth was apparent, but might be a factor of the sediment particle size and organic matter content. No PCB's were measured in Lac Donquan sediments though the same analytical method was not used in both cases.

Lac Fonteneau sediments probably stay in their basin for longer periods as the lake appears to have a longer residence time than that of Lac Donquan. As Lac Donquan is essentially a widening of the river, it is expected to have a higher flushing rate of sediments out of the basin. The longer residence time of Lac Fonteneau would ensure greater

chances of contact between any contaminants and suspended and deposited particles, so might account for the higher levels observed.

Results of fish tissue analysis show measurable levels of mercury in all samples. As the acceptable level for mercury in fish consumed in Canada is 0.5 mg/kg, it can be seen that some liver and muscle samples have values above acceptable levels. The liver, due to its physiological function, should have higher Hg concentrations than muscle tissue, but this is not necessarily the case. Neither is there a significant correlation between body size and mercury concentrations within species.

Of the other metals measured in fish, cadmium and lead were two contaminants which showed interesting results. A Muskelunge (Esox masquinongy) liver and Northern Pike (Esox lucius) gonads from Lac Fonteneau as well as a Northern Pike liver from Lac Donquan showed some measurable results. No muscle tissues showed detectable levels. In 1981, lead was also analyzed in Lac Fonteneau fish, with values at or near the detection limit in a Northern Pike muscle sample and a pike female egg mass.

As expected, muscle tissues in the piscivorous species of Lac Donquan. (Northern Pike and Lake Trout) have higher mercury levels in their flesh than the planktonic feeders. The opposite however, held for liver concentrations. Comparisons between the two lakes showed similar aspects of mercury concentrations.

The results, however, are not surprising. Bruce and Spencer (1979) report much higher values for the region around the Smallwood reservoir, some 200 km to the northwest of the study basins. They postulate that the bedrock in Labrador contains some mercury which may be released into the water column. This results in ambient levels, which though they cannot be measured in water and sediments, can accumulate in the biota. Bruce and Spencer (1979) also show that mercury levels in fish from recently flooded reservoirs are often one order of magnitude higher than those from undisturbed areas.

Cadmium and lead are both found in only a few scattered samples and at low concentrations, and are also probably caused by regional geology.

The organic contaminants found in fish were the long-lived organochlorines and arochlors. No correlation between size or weight and contaminants could be drawn, within species or lakes, unlike the results of Bache et al. (1972) on the lake trout.

Lac Fonteneau fish have measurable amounts of o,p-DDT and alpha-BHC, while these were not detected in Lac Donquan. The longer water retention time in the lake probably accounts for this, by allowing fish to be exposed to higher levels of contaminants in the sediments which would be picked up by benthic invertebrates.

The organic contaminant values measured in Labrador fish are rather low compared to values presented in the literature. Near Churchill Falls, Labrador, a major hydro development, PCB values ranged from 0.3 to 0.7 mg/kg (Musial et al. (1979), one to two orders of magnitude greater than these results, except for 1 Northern Pike liver value of 2.2 mg/kg. This value is difficult to understand, as it is one to two orders of magnitude greater than any other. Efforts were made to trace any possible source of contamination, both in the field and in the laboratory, but no problems could be detected. The value can represent either an anomalous, though real value, or else a contamination problem of undetected origin. Other Labrador values fell well below the ranges measured by Bache et al. (1972) for upstate New York and Monod and Keck (1982) for Lake Geneva, both of which are in industrialized areas.

The DDT and by-products residues found were also much lower than those reported for Roaches (Rutilus rutilus) in Norway (Kveseth 1981) or in Channel Catfish (Ictalurus punctatus) from Iowa (Bulkley 1978).

Comparisons of our results with those from other studies are very difficult to do for a number of reasons. The species caught and analyzed in the various studies were different due to location and other ecological reasons. The reporting of values often followed different protocols, going from mg of contaminant in wet tissue, as in this study, or by total body weight or by lipid weight. Another problem

in interpretation is that the sample sizes used in statistical analyses were too small.

Despite these limitations, however, it is obvious that the levels of all contaminants are quite low and present little danger to humans.

The positive values for organic contaminants in sediments and fish suggest that long-range transport of long-lived chemicals into southern Labrador must occur. Lund et al. (1977) have shown that between one and two tonnes of PCB's were deposited by precipitation in Norway, and it is quite likely that the same processes now occur for PCB's and organochlorines in Labrador.

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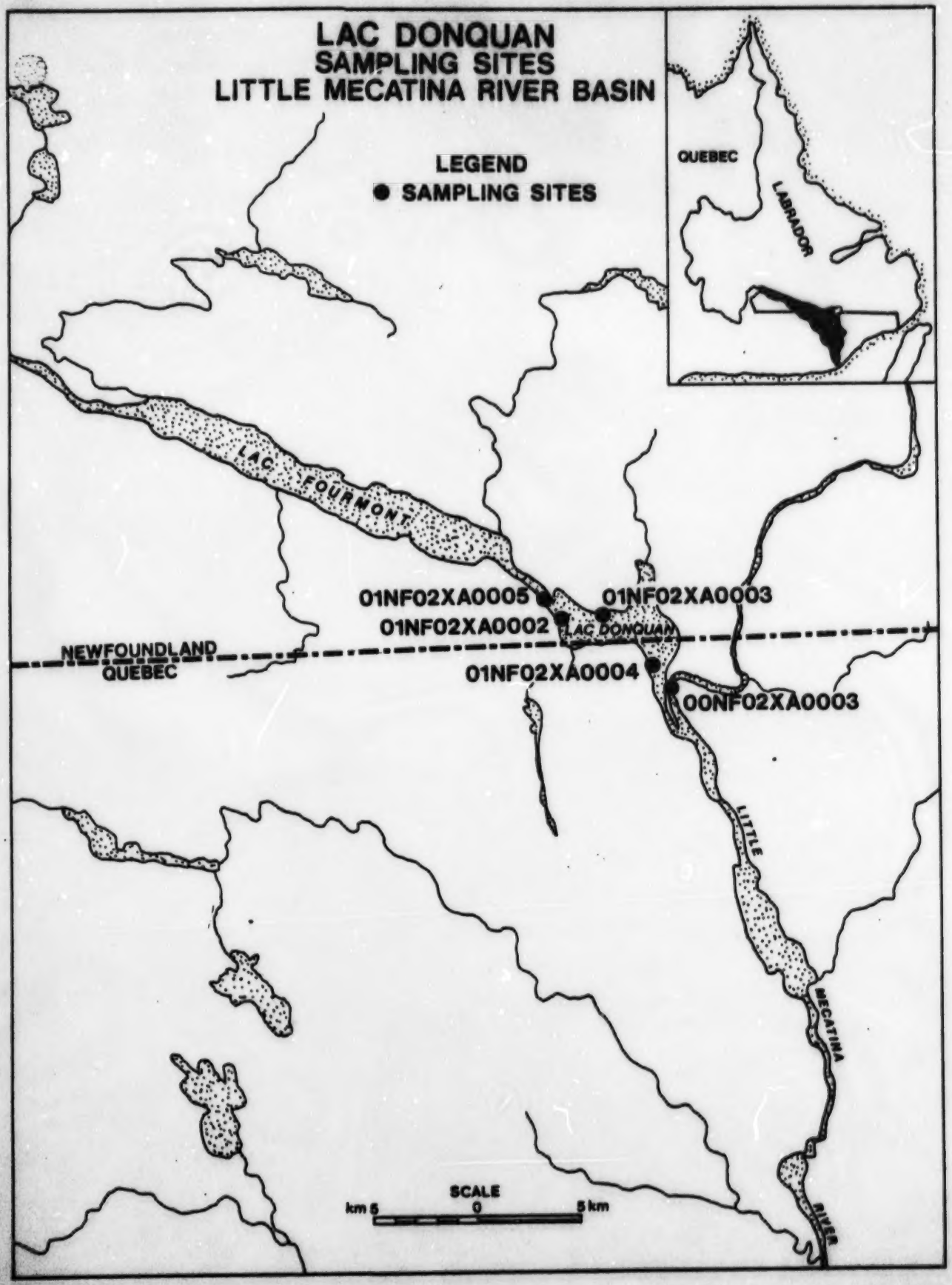
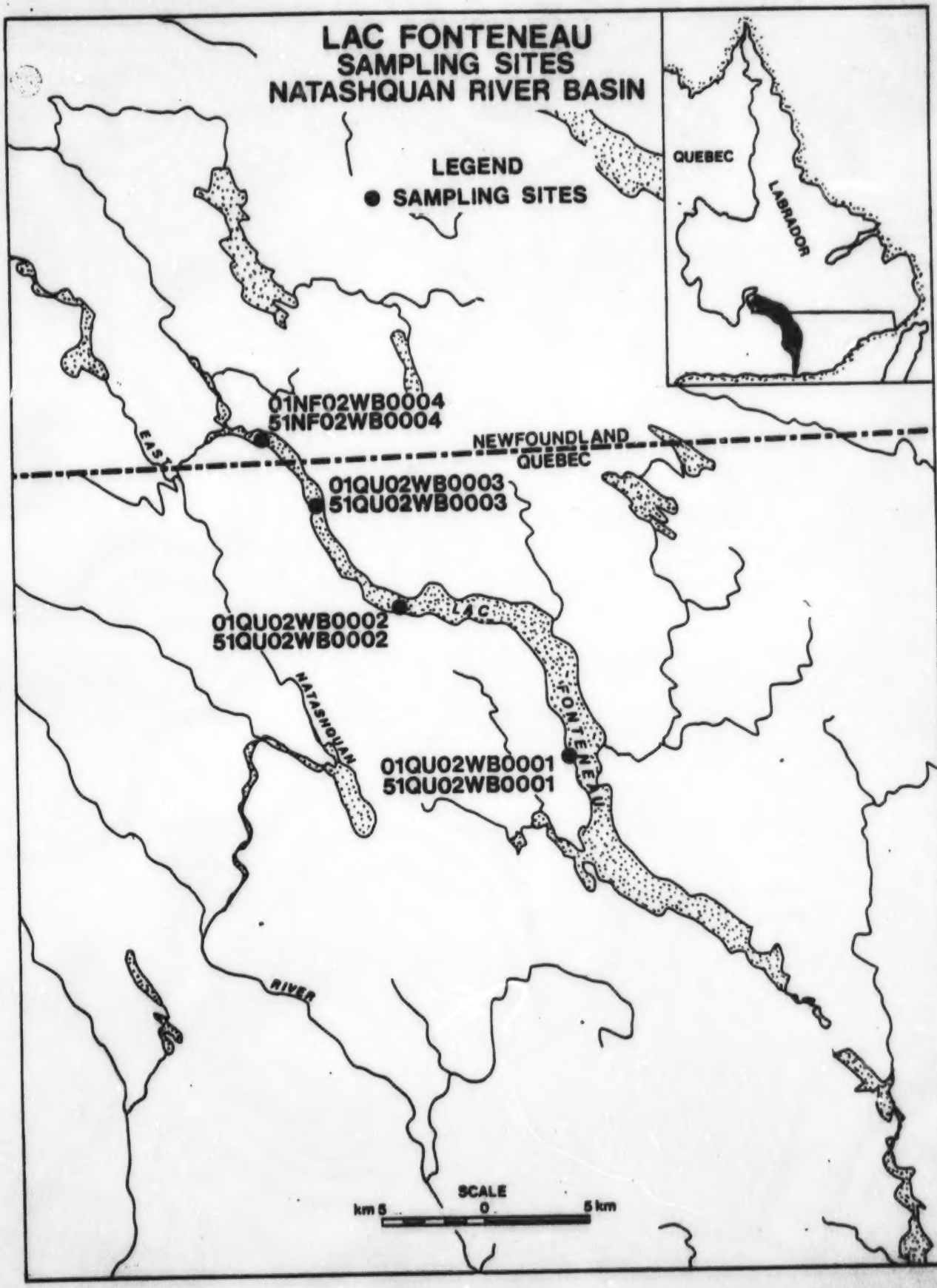

LAC DONQUAN
SAMPLING SITES
LITTLE MECATINA RIVER BASIN
LEGEND
SAMPLING SITES
QUEBEC
LABRADOR
LAC FOURMONT
01NF02XA0005
01NF02XA0003
01NF02XA0002
LAC DONQUAN
NEWFOUNDLAND
QUEBEC
01NF02XA0004
00NF02XA0003
LITTLE
MECATINA
RIVER
SCALE
km 5
0
5 km

FIGURE 1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LABRADOR
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NEWFOUNDLAND
QUEBEC
EAST
01QU02WB0003
51QU02WB0003
01QU02WB0002
51QU02WB0002
LAC
FONTENEAU
NATASHQUAN
01QU02WB0001
51QU02WB0001
RIVER
SCALE
km 5
0
5 km

FIGURE 2

TABLE 1

Stations Sampled - Little Mecatina Watershed - Lac Donquan, September 1980

NAQUADAT STATION #	NAME	LATITUDE	LONGITUDE	DATE SAMPLED
01NF02XA0005	Lac Donquan at Inlet of Little Mecatina River	52°00'56"	60°17'06"	19/09/80
51NF02XA0001	" " " " " (water depth 1 m.)	" " "	" " "	"
01NF02ZA0002	Lac Donquan 2.0 km S.E. of inlet to Little Mecatina River	52°00'24"	60°15'51"	19/09/80
51NF02XA0002	" " " " " (water depth 9 m.)	" " "	" " "	"
01NF02XA0003	Lac Donquan 3.9 km S.E. of inlet to Little Mecatina River	52°00'21"	60°13'48"	19/09/80
51NF02XA0003	" " " " " (water depth 11 m.)	" " "	" " "	"
01NF02XA0004	Lac Donquan at outlet	51°59'18"	60°12'51"	19/09/80
51NF02XA0004	" " " " (water depth 1 m.)	" " "	" " "	"
00NF02XA0003	Riviere Joir, 1 km upstream from Mecatina River	51°58'09"	60°12'12"	19/09/80
50NF02XA0003	" " " " (water depth 1 m.)	" " "	" " "	"

TABLE 1a STATIONS SAMPLED - LAC FONTENEAU, NATASHQUAN RIVER BASIN, SEPTEMBER 1980

NAQUADAT #	STATION LOCATION	LATITUDE	LONGITUDE	DATE SAMPLED
01NF02WB0004	Lac Fonteneau, 320 m north of Labrador-Quebec boundary	52°00'30"	61°40'06"	09/09/81
51NF02WB0004	" " " (water depth 21.3 m)	" "	" "	"
01QU02WB0001	Lac Fonteneau, 23 km south of interprovincial boundary	51°52'09"	61°27'58"	08/09/81
51QU02WB0001	" " " (water depth 10.7 m)	" "	" "	"
01QU02WB0002	Lac Fonteneau, 9 km south of interprovincial boundary	51°56'17"	61°34'54"	09/09/81
51QU02WB0002	" " " (water depth 14.9 m)	" "	" "	"
01QU02WB0003	Lac Fonteneau, 3 km south of interprovincial boundary	51°58'39"	61°38'56"	07/09/81
51QU02WB0003	" " " (water depth 26.5 m)	" "	" "	"

TABLE 2 PARAMETER VALUES - MAJOR IONS AND METALS IN WATER - LAC DONQUAN, SEPTEMBER 1980

STATION #	Temp field °C	pH field	pH lab	Spec Cond uS/cm	Diss O_2 mg/L	Turbidity JTU	Colour Rel.	Mg mg/L	Na mg/L	Ca mg/L	Alk mg/L (as $CaCO_3$)	Cl mg/L	F mg/L	SO_4 mg/L	Si mg/
01NF02XA0001	9.0	5.9	6.4	13.3	10.2	0.6	40.	0.38	0.7	1.4	3.0	0.40	0.04	2.5	2.9
01NF02XA0002	9.5	5.9	6.4	13.8	10.2	0.5	40.	0.38	0.7	1.4	3.8	0.30	0.04	2.3	3.9
01NF02XA0003	10.0	6.1	6.7	13.2	10.2	0.4	40.	0.38	0.7	1.4	2.4	0.40	0.03	2.3	3.0
01NF02XA0004	11.0	6.1	6.7	13.2	10.3	0.4	30.	0.38	0.7	1.4	4.2	0.40	0.05	2.3	3.3
00NF02XA0003	9.8	6.1	6.6	15.0	10.6	0.4	40.	0.42	0.7	1.6	4.1	0.50	0.03	2.7	3.5

STATION #	Total P PO_4 mg/L	$C_t$org mg/L	$C_t$inorg mg/L	Humic acid mg/L	NH_3 mg/L	N total mg/L	As total mg/L	Al ext mg/L	Fe extr mg/L	Sr mg/L
01NF02XA0001	0.008	6.5	1.0	4.1	0.040	0.27	L0.001	0.12	0.44	0.02
01NF02XA0002	0.008	9.0	1.0	4.4	0.015	0.11	0.008	0.12	0.39	0.02
01NF02XA0003	0.012	6.5	0.5	4.1	0.020	0.20	L0.001	0.12	0.38	0.02
01NF02XA0004	0.014	9.5	1.0	3.7	0.020	0.16	L0.001	0.13	0.42	0.02
00NF02XA0003	0.013	9.0	1.0	4.9	0.12	0.21	L0.001	0.10	0.57	0.04

TABLE 2a PARAMETER VALUES - MAJOR IONS AND METALS IN WATER - LAC FONTENEAU, SEPTEMBER 1981

STATION #	Temp. Field °C	pH Field	Spec. Cond. uS/cm	Turbidity JTU	Colour rel.	Ca mg/L	Mg mg/L	K mg/L	Na mg/L	Alkalinity mg/L (as $CaCO_3$)
01NF02WB0004	14.0	6.0	12.0	0.4	20.	1.05	0.25	0.1	0.6	1.6
01QU02WB0001	14.5	6.2	12.0	0.3	15.	1.0	0.25	0.4	0.6	2.3
01QU02WB0002	14.5	6.0	12.0	0.3	20.	1.0	0.25	0.2	0.6	1.6
01QU02WB0003	17.5	6.2	12.0	0.3	20.	1.0	0.25	0.1	0.6	1.6

STATION #	Cl mg/L	SO_4 mg/L	Al extr. mg/L	Fe extr. mg/L	Cu extr. mg/L	Zn extr. mg/L	Cd extr. mg/L	Hg extr. ug/L	Pb extr. mg/L
01NF02WB0004	0.3	2.0	0.07	0.16	L0.002	L0.002	L0.002	L0.020	L0.002
01QU02WB0001	0.4	1.8	0.07	0.11	L0.002	0.005	L0.001	L0.020	L0.002
01QU02WB0002	0.4	1.8	0.08	0.11	L0.002	L0.002	L.001	L0.020	L0.002
01QU02WB0003	0.3	2.0	0.07	0.14	L0.002	L0.002	L0.001	L0.020	L0.002

TABLE 3 METAL AND NUTRIENT PARAMETERS BELOW DETECTION LIMITS

NAQUADAT Code	Parameter	Detection Limit
25304P	Manganese (extractable)	0.01 ppm
29305P	Copper (extractable)	0.002 ppm
30305P	Zinc (extractable)	0.002 ppm
48302P	Cadmium (extractable)	0.001 ppm
80315P	Mercury (extractable)	0.02 ppb
82302P	Lead (extractable)	0.002 ppm
07110P	Nitrate-Nitrite	0.001 ppm
34007P	Selenium	0.001 ppm

TABLE 4 PESTICIDE PARAMETERS ANALYZED IN WATER AND SEDIMENTS FOR ALL SITES IN BOTH BASINS

NAQUADAT Code water	(sediment)	Parameter	Detection Limit (ug/L water)	(mg/kg sediment)
18125L	(18124L)*	Mirex	0.001	0.005
18000L	(18009L)	p,p-DDT	0.001	0.001
18005L	(18008L)	o,p-DDT	0.001	0.001
18010L	(18012L)	p,p-DDD	0.001	0.001
18020L	(18026L)	p,p-DDE	0.001	0.001
18030L	(18034L)	p,p-methoxychlor	0.01	0.05
18040L	(18043L)	Heptachlor	0.001	0.001
18045L	(18048L)	Heptachlor Epoxide	0.001	0.001
18050L	(18054L)	Alpha-endo-sulfan	0.01	0.01
18055L	(18058L)	Beta-endo-sulfan	0.01	0.01
18060L	(18063L)	Alpha-Chlordane	0.005	0.005
18065L	(18068L)	Gamma-Chlordane	0.005	0.005
18070L	(18079L)	Gamma-BHC	0.001	0.001
18075L	(18074L)	Alpha-BHC	0.001	0.001
18130L	(18133L)	Aldrin	0.001	0.001
18140L	(18143L)	Endrin	0.01	0.01
18150L	(18153L)	Dieldrin	0.001	0.001
18164L	(18169L)	Arochlors	0.005	0.005
	(18177L)*	Arochlors		0.005

* only in Natashquan basin

TABLE 5 METAL PARAMETERS ANALYZED IN FISH TISSUES

NAQUADAT Code	Parameter	Detection Limit (mg/kg)
29601L	Copper (total)	0.2
82601L*	Lead (total)	0.05
30601L	Zinc (total)	0.2
26601L	Iron (total)	0.02
13601L	Aluminum (total)	2.0
48601L	Cadmium (total)	0.025
80602L	Mercury (total)	0.02

* only in Natashquan basin

TABLE 6 PESTICIDE PARAMETERS ANALYZED IN FISH TISSUES

NAQUADAT Code	Parameter	Detection Limit (mg/kg)
18001L	p,p-DDT	0.001
18006L	o,p-DDT	0.001
18011L	p,p-DDD	0.001
18021L	p,p-DDE	0.001
18031L	p,p-methoxychlor	0.05
18041L	heptachlor	0.001
18046L	heptachlor epoxide	0.001
18051L	alpha-endosulfan	0.01
18056L	beta-endosulfan	0.01
18061L	alpha-cis-chlordane	0.005
18066L	gamma-trans-chlordane	0.005
18071L	lindane (gamma-BHC)	0.001
18076L	alpha-BHC	0.001
18131L	aldrin	0.001
18141L	endrin	0.01
18151L	dieldrin	0.001
18169L	arochlor (total)	0.005

TABLE 7 CONCENTRATIONS OF METALS IN FISH TISSUE SAMPLES IN MG/KG - LAC DONQUAN 1980
(wet weight)

Fish Sample	Hg	Cd
Livers		
N.P. - 2	0.31	0.10
N.P. - 4	0.16	L0.005
W.F. - 2	0.76	-
W.F. - 4	1.18	-
Muscle		
N.P. - 1	0.90	L0.025
N.P. - 2	0.36	L0.025
N.P. - 3	0.46	L0.025
N.P. - 4	0.43	L0.025
N.P. - 5	0.20	L0.025
N.P. - 6	0.89	L0.025
W.F. - 2	0.14	-
W.F. - 3	0.11	-
W.F. - 4	0.11	-
W.F. - 5	0.08	-
L.T. - 1	0.59	L0.025
Gonads (M)		
N.P. - 6	0.21	L0.025
W.F. - 3	0.07	-
Gonads (F)		
N.P. - 5	0.29	L0.025
W.F. - 6	0.02	-
L.T. - 1	0.18	L0.025

TABLE 7a CONCENTRATIONS OF METALS IN FISH TISSUE SAMPLES - LAC PONTENEAU, NATASHQUAN RIVER BASIN (mg/kg, wet weight)

Fish Sample #	Hg	Cd	Pb
Liver			
N.P. - 2	0.17	L0.025	L0.05
N.P. - 4	0.53	L0.025	L0.05
N.P. - 6	0.12	-	-
N.P. - 8	0.36	-	L0.05
N.P. - 11	0.73	-	-
N.P. - 14	0.08	-	-
M - 2	1.0	0.06	L0.05
Muscle			
N.P. - 1	0.32	-	L0.05
N.P. - 2	0.27	-	L0.05
N.P. - 4	0.49	L0.025	0.05
N.P. - 6	0.18	L0.025	L0.05
N.P. - 8	0.73	L0.025	L0.05
N.P. - 10	0.49	-	L0.05
M - 2	0.41	-	L0.05
Gonads - M			
N.P. - 2	0.05	0.04	L0.05
Gonads - F			
N.P. - 4	0.09	-	L0.05
N.P. - 10	0.13	-	L0.05
N.P. - 11	0.25	0.05	0.08
M - 2	0.15	L0.025	L0.05
M - 4	0.05	-	-

TABLE 8 DETECTABLE PESTICIDE LEVELS IN LAC DONQUAN FISH (MG/KG)
wet weight

Sample #	Liver	Muscle	Gonads	
			Male	Female
p,p-DDE				
NP-1	0.004	0.016	-	*
NP-2	-	L0.001	-	L0.001
NP-3	0.017	L0.001	-	0.004
NP-4	0.017	L0.001	*	-
NP-5	0.023	L0.001	-	*
NP-6	0.120	0.004	*	-
WF-1	0.010	-	*	-
WF-2	-	0.01	0.01	-
WF-3	0.003	0.002	*	-
WF-4	-	0.003	*	-
WF-5	-	L0.001	-	*
WF-6	Trace	0.001	-	0.006
LT-1	0.001	0.120	-	0.130
Arochlors				
NP-1	2.20+	0.027	-	*
NP-3	0.01	L0.005	-	L0.005
NP-4	0.01	L0.005	*	-
NP-6	0.25	L0.005	*	-
LT-1	0.14	0.068	-	0.110

* denotes sex only of fish, no analysis was done on the sample
\+ contamination suspected

TABLE 8a DETECTABLE PESTICIDE LEVELS IN LAC FONTENEAU FISH
(mg/kg, wet weight)

Sample #	Liver	Muscle	Gonads	
			Male	Female
o,p-DDT				
NP-1	0.001	LO.001	-	LO.001
NP-3	Trace	LO.001	LO.001	-
NP-5	0.005	LO.001	LO.001	-
NP-7	Trace	LO.001	-	LO.001
NP-9	0.001	LO.001	-	-
NP-12	0.001	LO.001	-	LO.001
NP-13	0.002	LO.001	LO.001	-
NP-15	Trace	LO.001	-	LO.001
M -1	0.001	LO.001	-	LO.001
M -3	Trace	LO.001	-	LO.001
p,p-DDE				
NP-1	0.03	Trace	-	0.009
NP-3	0.001	Trace	0.002	-
NP-5	0.02	Trace	0.065	-
NP-7	Trace	Trace	-	0.008
NP-9	0.03	Trace	-	-
NP-12	0.003	Trace	-	0.02
NP-13	0.006	Trace	0.044	-
NP-15	0.008	Trace	-	0.005
M-1	0.006	Trace	-	0.006
M-3	Trace	Trace	-	0.005
alpha-BHC				
NP-1	0.001	LO.001	-	LO.001
NP-3	0.001	LO.001	LO.001	-
NP-5	0.001	LO.001	LO.001	-
NP-7	Trace	LO.001	-	LO.001
NP-9	0.002	LO.001	-	-
NP-12	0.001	LO.001	-	LO.001
NP-13	0.001	LO.001	LO.001	-
NP-15	0.001	LO.001	-	LO.001
M-1	Trace	LO.001	-	LO.001
M-3	0.001	LO.001	-	LO.001
Arochlors				
NP-1	0.023	LO.001	-	0.006
NP-3	0.019	LO.001	Trace	-
NP-5	0.091	LO.001	0.01	-
NP-7	0.007	LO.001	-	-
NP-9	0.019	LO.001	-	-
NP-12	0.017	LO.001	-	Trace
NP-13	0.048	LO.001	0.09	-
NP-15	0.008	LO.001	-	0.007
M-1	0.010	LO.001	-	Trace
M-3	0.013	LO.001	-	Trace

APPENDIX I

PHYSICAL DESCRIPTION OF 13 FISH ANALYZED FOR METALS AND PESTICIDES FROM LAC DONQUAN 1980

Species & Sample No.	Weight (kg)	Fork Length (mm)	Total Length (mm)	Sex
Northern Pike - 1 (*Esox Lucius*) (N.P.)	1.5	720	750	F
Northern Pike - 2	1.5	650	675	F
Northern Pike - 3	3.0	785	830	F
Northern Pike - 4	3.2	735	780	M
Northern Pike - 5	1.4	480	530	F
Northern Pike - 6	2.7	775	815	M
Whitefish - 1 (*Coregonus clupeatormis*) (W.F.)	1.5	500	540	M
Whitefish - 2	1.4	440	500	M
Whitefish - 3	1.4	470	525	M
Whitefish - 4	1.4	475	520	M
Whitefish - 5	0.5	350	390	F
Whitefish - 6	1.8	490	550	F
Lake Trout - 1 (*Salvelinus namaycush*) (L.T.)	5.8	775	835	F

APPENDIX II

PHYSICAL DESCRIPTION OF FISH ANALYZED FOR METALS AND PESTICIDES FROM LAC FONTENEAU - NATASHQUAN BASIN 1981

Species & Sample No.	Weight (kg)	Fork Length (mm)	Total Length (mm)	Sex
Northern Pike (N.P.-1)	4.5	876	914	F
(Esox lucius)				
Northern Pike - 2	1.8	641	680	M
Northern Pike - 3	1.0	584	610	M
Northern Pike - 4	1.4	622	660	F
Northern Pike - 5	0.9	559	591	M
Northern Pike - 6	1.4	597	610	M
Northern Pike - 7	1.1	572	597	F
Northern Pike - 8	2.0	686	711	M
Northern Pike - 9	0.9	546	572	-
Northern Pike - 10	4.3	826	864	F
Northern Pike - 11	1.6	648	673	F
Northern Pike - 12	1.6	648	673	F
Northern Pike - 13	0.9	572	610	M
Northern Pike - 14	0.5	483	521	M
Northern Pike - 15	1.6	648	686	F
Northern Pike - 16	1.4	597	622	M
Northern Pike - 17	0.9	546	584	M
Northern Pike - 18	0.9	533	559	M
Northern Pike - 19	0.9	559	584	M
Muskellunge (M.-1)	1.4	648	686	F
(Esox masquinongy)				
Muskellunge - 2	0.7	559	584	F
Muskellunge - 3	1.1	610	635	F
Muskellunge - 4	0.9	572	591	F